ENVIRONMENTAL IMPACT ASSESSMENT

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BACKGROUND TO PAPER

Most developing nations have embarked on a path to rapid economic growth. This has meant soliciting for many development projects which are meant to bring rewards in increased industrial productivity. The hope is that these projects will increase the incomes of the people and cut down on unemployment. However past experiences have shown that these major development projects created with the aim of producing enormous socio-economic benefits, have also produced adverse environmental impacts. Some of these impacts are irreversible and the damage to the environment has been total. So in order to minimise the unintended negative externalities of these projects on the environment, there has to be some means of identifying the impacts of projects before they are embarked upon so that any adverse effects which the projects may produce on the environment can be rectified or an alternative method which does not damage the environment is worked out. **Environmental Impact Assessment (EIA)** is the technique used to identify the likely impacts of a development project on the environment.

Ideally this activity of EIA should be carried out at the early planning stages of projects. When carried out effectively, it will help to identify the probable facets of environmental degradation which will be due to the development activities. This technique provides the decision-makers with an insight into the environmental implications of proposed development projects and their alternatives. It will provide the decision maker with information on the environmental, health, and socio-economic impacts of an intended development project. The implication is that this technique should be an integral part of development plans and is an important decision making tool for all projects if damage to the environment is to be avoided.

This paper is meant to acquaint students with **EIA** as a decision making tool in development planning. It covers all aspects relating to EIA activities from the objectives and scope of EIA; EIA methods; institutional set-up ; and the Zimbabwe situation as far as this activity is concerned. The environment in this paper is taken to mean the set of conditions surrounding an individual or event. These conditions could be physical, biological or socio-economic in nature. The paper focuses on the technique used to identify impacts of development projects on these various facets of the environment. Those in the planning profession, decision makers and project planners will find this paper useful.

SECTION 1

1. 0 THE NEED FOR EIA

Most governments are becoming increasingly aware of the dangers of some of the environmental problems which can be unleashed by development projects. According to Beale (1976), most governments find themselves confronted by a number of dilemmas concerning the relationship between the environment and development. The first dilemma relates to the nature of development which is desirable. It is true that most, if not all developing countries require development of one kind or the other to raise standards of living of their populations. However most development projects which have been introduced have resulted in several environmental problems. In some cases pollution of the environment has increased and in other cases there has been loss of environmental amenity as a result of the introduction of a particular type of a project. The issue therefore becomes one of trying to make sure that the projects which are introduced do not damage the environment. Development is needed but it must be the right type of development which does not damage the environment beyond a certain point.

The second dilemma relates to the depletion of natural resources which may occur with development if there is no proper planning. Developing countries are primarily natural resource based with very small industrial sectors and high population growth rates. The need for explosive agricultural exploitation, pastoral pursuits and mining have resulted in a number of environmental problems. The issue becomes one of using natural resources without getting into an environmental crisis situation of reckless depletion and damage to the environment. There is therefore need to try and make sure that whilst the exploitation of natural resources takes place, the resultant problems associated with it are minimised as much as possible. Figure 1 shows some of these relationships between man's demands on the environment.

The environment will always provide those functions mentioned in the figure as long as there is no over exploitation. However the problems depicted can also occur as a result of reckless exploitation of the environment. These problems mean that the environment as a system will fail to provide the services demanded of it and a crisis situation develops. It is one of the main tasks of EIA to make sure that the environment is not damaged to the extent of failing to perform its functions efficiently.

There should be compatibility between the environment and development. This can be achieved if economic growth is adapted to the natural environmental conditions. This is in order to avoid problems of pollution, depletion of resources or the general

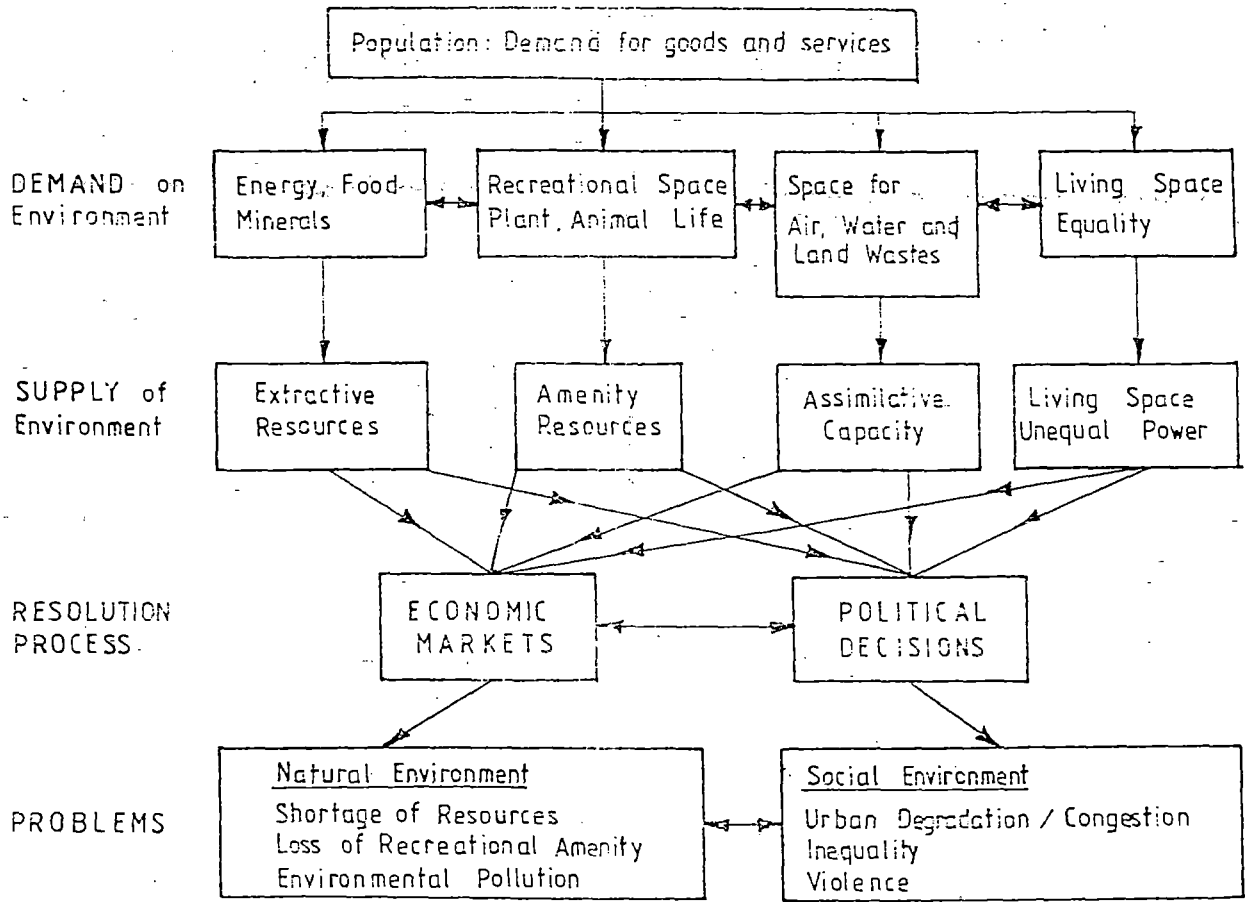
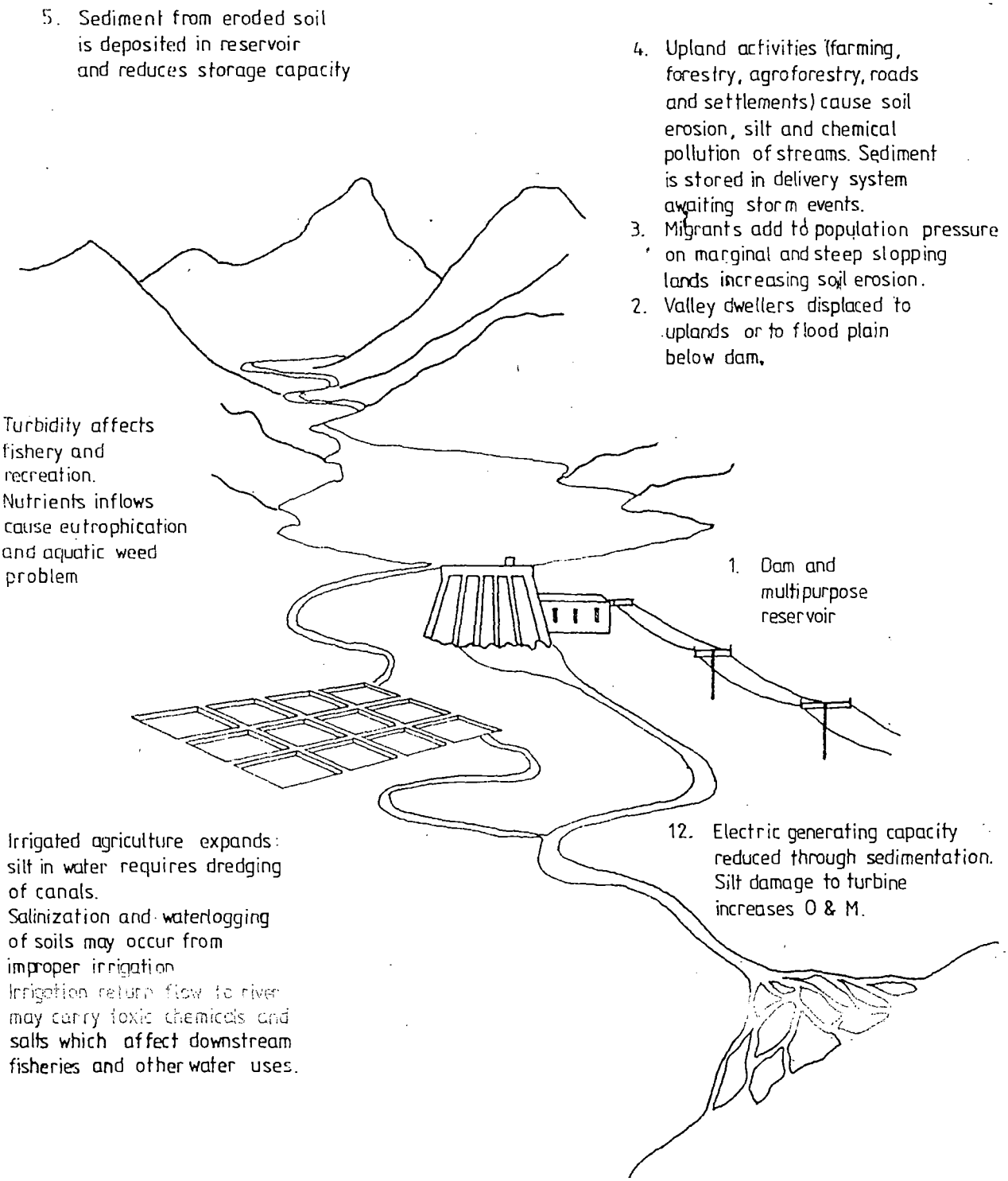


Figure 1 An overview of environmental problems

SOURCE ABELSON, 1979

FIGURE 2 : Multipurpose Dam Project: Loss of Economic Development Opportunities



SOURCE DIXON et al (1986)

degradation which may be associated with development projects. Projects like the Aswan Dam in Egypt which was constructed to boost economic development almost failed to deliver the goods because of the environmental problems which it left in its wake. There was loss of fish caught in the delta area due to reduced plankton levels as most was trapped in the dam upstream, increased erosion downstream caused loss of soil fertility and disrupted the communities which relied on the rich silt which the Nile River used to deposit but was now being trapped by the dam. Fig 2 adopted from Dixon et al(1988) clearly puts into perspective some of the environmental problems which can be triggered off by development projects along a river which are poorly planned

Even in prehistoric times environmental problems were recognised. According to Munn (1979), the burning of coal was long recognised as a major cause of air pollution in London as early as the 14th century. Penalties for its use were imposed even during this early period. The Tennessee Valley Authority in the USA was instituted to comprehensively deal with problems relating to water projects. The approach adopted meant looking at the project area itself and then the other riparian areas which could be potentially affected by the water project.

1.1 Nature of Impacts

The above discussion has shown that most, if not all development projects will have some kind of impact on the environment. Although the above discussion has tended to focus on the negative impacts only , projects can have positive impacts as well, which in all cases is the primary reason why they (the projects) are initiated. There is need to minimise the negative impacts of projects. The only way to do this is by carrying an Environmental Impact Assessment study before a project is carried out. Munn (1979) defines EIA as 'an activity designed to identify and predict the impact on the biogeophysical environment and man's health and well-being of policies, programmes and projects and to interpret and communicate information about impacts.' Indeed it is a structured approach and formal set of procedures for ensuring that environmental factors are taken into account at all levels in planning decision making.

Two main features image from the above definition:
a) that the impacts are on the biogeophysical environment as well as on man's health and well-being and
b) the need to interpret and communicate the impact information.
The first feature means concern with ecological and physical impacts. This means looking at the impacts in the context of soil erosion, pollution, biological diversity and resource provision. On the other hand the socio-economic impacts are important. These are those impacts relating to society and its economic activities. Most projects will result in a change in productivity or some people will be required to move to make way for the project to be carried out. The important issue as far as society is concerned is

that there will always be costs and/or benefits to the group as a result of a project taking place in their neighbourhood. It is these impacts which EIA will be concerned with on the human side. A comprehensive EIA should bring out all these issues - ie the human and the biophysical concerns.

Of importance also is the need to interpret and communicate the impacts. This calls for some special skills. To interpret the impacts one must have thorough knowledge about the environment in which he/she is working. In most cases the environments in developing countries have not been properly mapped out. At times it is also very difficult to interpret the impacts given the degree of uncertainty that surrounds some of these changes within the environment. The key to this problem lies in the predicting or forecasting technique used to ascertain the changes. These will be discussed later.

Related to the above is the need to communicate the impacts to the decision makers and the affected community. The decision-makers can then take decisions presumably with a view to minimising the negative impacts on the environment. The community to be affected also has to be brought into the picture in terms of how a particular project is going to affect them. Ideally they should be able to contribute to the impact study and should be able to oppose any development which will affect them and their environment negatively.

EIA should be carried out to ascertain impacts which are likely to occur during three main phases of a project. Munn (1979) has conveniently divided these into:

a) During construction: the environment will be greatly affected during this phase. All those project which are likely to damage the environment must be identified and the nature of their impacts worked out. Mostly the actions will be in the form of tree cutting, earth moving or the introduction of construction materials which are different from those naturally occurring in the area. People may also be required to move. So there is need to have as accurate information as possible during this phase.

b) **Upon completion** : A new environment will have been created and there is need to make sure that if there are any impacts which may not have been predicted, these are taken care of. Mitigatory work can then be carried out to make sure that the environment is rehabilitated to its original condition.

c) Over a long period of time: the mitigatory measures which may have been carried out after the project was complete will need monitoring to make sure that everything is going according to plan. There is also need for long term monitoring to make sure that no damage occurs to the environment as a result of secondary activities which may be attracted into the area as a result of project development.

For effectiveness, the prediction of impacts also assumes a spatial

dimension. Impacts must be looked at from three main scales:
a) **The immediate surroundings:** this refers to the area where th project will be situated. This is the area where most of th impacts will be severe.
b) **The neighbourhood:** the immediate area on the periphery of th actual action site. Impacts may spill into these areas e downstream areas will always be affected a water project upstrean
c) **Wider area:** may take the regional context in cases where impact reach out far. These can be impacts with national significance These are rare impacts and the discussion which follows is largel related to the first two.

SECTION 2:

2.0 AIMS AND OBJECTIVES OF EIA

The main aim of EIA is to predict the impacts of projects on the environment and advise on the best alternative which has minimum adverse impacts. This means that EIA should be carried out before a decision is taken on whether to go ahead or not with a project. The EIA should therefore be carried out during the design stage of a project as is suggested by Dixon et al (1988) in fig 3.

The stages of project identification through to the appraisal stage are the most crucial ones for EIA. This is the time when the vigorous pursuit of carrying out the activity should be undertaken. The appraisal stage should not only consist of financial appraisal but the environment must be also taken into account. A project should be carried out because of its soundness also on the environment. The implementation phase also requires constant monitoring to make sure that any environmental protection measures are adhered to. The above shows that EIA should be an integral part of the project planning and management cycle as its objectives are largely to ensure the success of the project by making it environmentally sound.

2.1 Contents of EIA

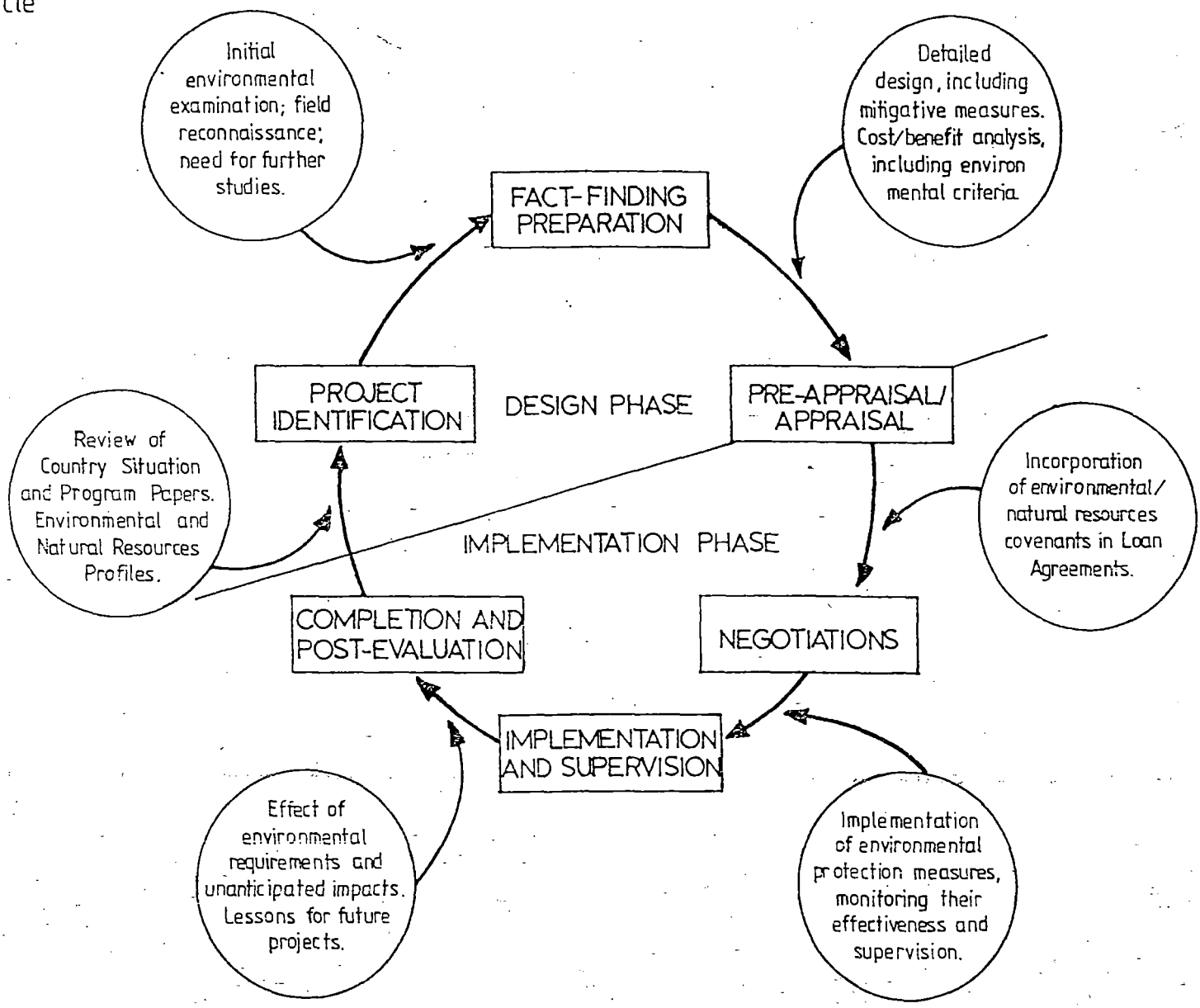
Perhaps the best way to look at the aims and objectives of EIA is to look at the contents of EIA as Munn (1979) has done. These will then give us an indication of what EIA is supposed to do. That its main aim is to predict impacts is already given. However there are also a number of objectives which it aims to accomplish. These are as follows:

1. to describe the proposed action as well as alternatives. This relates to the project activities. It is the project action which is responsible for causing the physical damage on the environment and usually a project has more than one activity. So these have to be carefully described and wherever possible alternative action to achieve the same results must also be described so that at least the one that produces the least damage is selected. The most common types of project actions are listed below:

Table 1 Common project actions

Project	Action/ results
a) Landuse and transformation	Urban, industrial, agricultural, transportation, transmission lines, etc.
b) Resource extraction	Drilling, mining, blasting, lumbering commercial fishing & hunting
c) Resource renewal	Reforestation, wildlife management, fertilization, waste recycling, flood

FIGURE 3
Project Cycle



Source : Asian Development Bank (1986), Environmental Planning and Management · Dixon et al

	control.
d) Agricultural processes	Farming, ranching, dairying, feedlots irrigation.
e) Industrial processes	Iron and steel mills, petrochemical industry, smelters, pulp & paper plants
f) Transportation	Railways, aircraft, automobiles, trucks, shipping, pipelines
g) Energy	Man-made lakes, dams, oil, coal-fired and nuclear stations
h) Water disposal	Ocean dumping, land fill, environmental contaminants and toxic substances, biological emissions.
i) Chemical treatment	Insect control, weed control (pesticides and herbicides)
j) Recreation	Hunting areas, parks, resort development

Adapted from Munn, 1979.

It does not follow that all actions will have negative impacts on the environment. Some may improve it eg land and wildlife management projects. It is actions which involve the removal of vegetation or tempering with the soil which will have the most adverse impacts.

2. to estimate the nature and magnitudes of likely environmental changes due both to natural processes and project actions. The effect of project actions is to accelerate the rate of environmental changes. It is the magnitude - seen in terms of whether a change is reversible or not - which is very important. If a change is irreversible , then that impact is great. These are the kinds project actions which need careful revision, with a view to lessening their impacts. Rates of change are also important in giving an insight into environmental changes. Some changes occur very quickly and others slowly. In most cases the slow occurring changes are easier to arrest than those that occur quickly. So one of the objectives of EIA is to determine this rate of environmental change as a result of a project action.

3) identify the relevant human concerns. Ultimately all planning

activities are meant to enhance society. It is imperative that the pertinent human concerns are identified and any developments to be introduced into an area are in line with the community to be affected. It is through this means that the project avoids antagonizing itself with the people.

4. define the criteria to be used in measuring the significance of the environmental changes. Criteria selected must be quantifiable.

5. estimate the significance of the predicted environmental changes ie estimate the impacts of the impacts . The aim of this objective is to see how extensive a particular impact is. This will help determine the significance of an impact.

6. make recommendations for one of the following:
   i) acceptance of the project - if the impacts are not great or are negligible , the project can be adopted.
   ii) remedial action : if there is some way of lessening an impact,this can be adopted before a project begins. In most cases projects will require these mitigating measures to lessen impacts
   iii) acceptance of one or more alternatives: where a choice exists the alternative/s with the least disruptive effect on the environment should be recommended.
   iv) rejection: if all the alternatives have adverse impacts on the environment and there are no mitigating measures which can be adopted to lessen the impacts then the recommendation can be for rejecting the development. This where some people may think that EIA aims at blocking development. This is missing the point. The main aim is to harmonise development with the environment. So if that development is going to damage the environment then the costs to be borne later on may be too great. So for the sake of sustainable development such projects can be rejected.

7. make recommendations for inspection procedures to be followed after the action has been completed. Monitoring is very important for the success of EIA. One of the main aims therefore is to make sure that a monitoring team is in place and will continue to function even after the project has been completed . This is to make sure that there are no unanticipated impacts which may damage the environment. Monitoring is also important for the purpose of ensuring that the damaged environment is regenerating back to its original state.

Ultimately all these aims are meant to ensure that development and the environment are harmonised. Development today must be sustainable so that future generations can also rip the same benefits as the older generation from the environment. These aims described above can only be realised if the objective of getting proper data for the various project actions is properly carried out. The level of data required will depend on :

1. the sensitivity of the environment - if the environment is too sensitive then more data on the various facets of the environment will be required.
2. the scale of the proposed project is also important. In most cases it is the large scale projects which have the greatest potential of disrupting the environment. There is need to gather comprehensive data for these large scale development projects.
3. social value placed nationally or locally on preserving or enhancing environmental quality. If the environment is given national importance then it becomes more imperative for protective measures against any damage to it, hence rigorous requirements will be set for its protection from the harmful effects of development projects.
4. resources and scientific expertise available in the country. The exercise of gathering data and analysing it requires properly trained manpower. Lack of this manpower can mean that it would be difficult to gather all the data that would be required for an impact study.
5. the time available for the assessment. If assessment is left until too late, there may not be enough time for assessment to be carried out. Instead only a cover-up job is done which does not detail the magnitude of impacts. The Zambezi Valley Important Issues Study by Mobil Oil is a good example here. Mobil Oil only had two months in which to carry out the study and come up with a report. As a result of this time constraint the proper procedure for an impact study was not observed, ie consultation with the people and quantification of impacts. As a result there were many gaps in this study and an imbalanced picture of impacts was presented from a largely descriptive analysis.

SECTION 3

3.0 EIA PROCESSES AND METHODS.

The adaption of EIA procedures does not necessarily mean the successful preparation of an EIA statement. It is the methods which are ultimately selected during its preparation which give EIA credibility in terms of it being a useful predictive tool. According to Bisset (1983), EIA methods are concerned with various aspects of assessment such as the identification or description of likely impacts. Methods may also incorporate means whereby impacts can be scaled, weighted and compared for relative importance. They aid the collection and classification of impact data. On the other hand EIA processes refer to the procedures which have to be followed in the quest for data that will be used in assessing the impacts. This section will begin by looking at the procedures necessary for instituting EIA and then move on to the methods and techniques used to gather and analyse the information.

3.1 Screening

Before a project commences or EIA is carried out, the project must be screened to see if a full scale EIA is necessary. This first stage is really meant to make sure that only those projects with anticipated negative impacts are subjected to the EIA exercise. This way resources will not be wasted on cases where the negative impacts are minimal. The screening exercise is done by a team of experts on environmental issues.

3.2 Scoping

This is the second task to be carried out when initiating EIA. The scoping process is done to identify the range of actions, alternatives and impacts to be considered in depth in the impact statement. This process is also meant to narrow down the important issues to be considered by identifying and eliminating from detailed study the issues that are not significant for a particular project. These can be issues that have already been covered and reviewed elsewhere in other impact studies.

Ideally, people who have interest in the project come together at an early stage to identify the main issues to be considered by an EIA before the project is started. This group of people comprises the public, the client, developer(s), experts and decision makers. The public or their representatives are involved at this stage to identify those aspects within their environment which they value mostly and how these aspects will be affected by the proposed developments. All the expectations of the public are voiced during this scoping phase. The issues identified by the public as being important are very vital for the EIA study. Experts will also provide inputs on various aspects of the proposed development and

its relationship to the environment.

The scoping process is also meant to provide an opportunity to identify secondary impacts or other actions that are closely related or interdependent. Such secondary impacts will have to be subjected to careful study to unravel any negative impacts which may arise as a result of certain project actions. If related impacts are dealt with in a disjointed manner, it will not be possible to come up with a correct impact statement. So the relationship between projects has to be followed up right up to its logical conclusion. The scoping phase provides an opportunity to identify this intricate relationship through the brainstorming exercise that characterises this phase. Information from the various groups of people who form the team is used in the exercise.

Once the various important issues have been identified, the mitigating measures which can be adopted will also be discussed during this period. These are the measures which can be used to lessen the negative impacts of project actions on the environment. These can be selected from the list of alternative project actions which will have been discussed during this scoping phase.

Another important issue for this phase is to ensure that there is a relationship between the timing of the EIA and the local authority's decision making schedule. The assumption here is that the local authority has powers to make decisions on projects. This timing will ensure that the local authority is able to use the information provided in its own planning schedules in terms of either setting up a monitoring term or some activity on the project that requires the presents of the local authority. The scoping exercise must make sure that the project is tied in to the administrative structure of the decision making machinery. This way conflicting decisions are avoided. However the whole business of involving the public and the bureaucratic rigmarole which scoping creates can act negatively on the EIA study. Some of these issues are discussed later.

The scoping procedures should ideally involve the following:
1. A systematic approach with a set of assessment materials that cover the range of probable impacts and are easily used by scoping participants.
2. An independent scoping coordinator (mediator) who is not affiliated to the sponsoring client . It should also have an impact specialist who is employed by the sponsoring body. The specialist will work closely with the independent coordinator and the public involvement committee.
3. Program of public involvement with a committee representing the broad interests of society at large.
4. There should also be a budget and timing schedule appropriate for the study.

The assessment materials are supposed to aid in facilitating discussion. These normally include checklists, reference manuals and assessment forms keyed to impact topics which are broken down into subtopics. It becomes easier therefore to prioritise the anticipated negative impacts using these guides. This sifting of issues, which establishes tentatively the direct and indirect impacts is important for screening purposes. It makes sure that all the relevant issues have been dealt with. However public participation may wane if there is no strong coordinator. The group's interests have to be seen to moving towards some specific product if this stage is to succeed.

The group coordinator is critical in the effectiveness of the group discussions. The coordinator must be able to organise and deal with small to large groups of people. Knowledge of environmental issues and planning methods and policies are crucial to the coordinator. The coordinator must be familiar with these issues if he/she is to be effective. Knowledge of group dynamics is also very important. Lastly the coordinator must appear to be uncommitted to merits and problems of the projects lest he/she be accused of taking sides.

Public participation can take a number of forms. It can take the form of massive scale techniques eg through public hearings, soliciting written inputs, mass media or key contacts. It can also take the form of small group techniques in workshops, ad hoc committees, advisory groups or boards. These techniques have to be employed to identify values and perceptions of different people affected by proposed project.

According to Pease (1984), public participation can be through broad and balanced representation. Broad and balanced representation involves picking people to represent the community at large. The group that will have been selected will later on have to select spokesperson/s. It is preferable if there are more than one issues of interest to have several spokespersons so that the dynamic balance in views is established. This way one interest group will not dominate the others and maximum interaction is encouraged. Technical experts on the various issues can be invited to participate at the meetings. Publicity about scoping exercises can done through the media. However at times it is difficult to get people to attend these meetings. In any case the more people there are the greater will be the points of friction and the longer it will take to resolve issues. Therefore the smaller group participation techniques are preferable although the representation may not be total in the final analysis. Smaller groups technique encourage maximum participation by those who will be representing others.

3.3 METHODOLOGIES

There are a number of methods which can be used to identify environmental impacts of projects. These methods differ in terms details which can be extracted about environmental information. Some are also complex in terms data inputs which they require. Perhaps the best way to look at the available methods is to adopt a generic classification. Five broad groups of methods emerge, namely:

a) checklists
b) matrices
c) networks /flow diagram approach
d) overlays
e) quantitative /index method.

3.3.1 Checklists

This is perhaps the simplest method which one can initially adopt for EIA. The lists are of environmental factors and will be looked at against the project actions. At times these lists take the form of a questionnaire. However it is important to note that the checklist approach can be used at the beginning to give the assessors an indication of the factors they will have to concentrate on for greater detail.

i) Simple Lists

These contain only a list of environmental factors. They are used largely as a guide in focusing the attention of those undertaking the EIA exercise on the factors listed. This ensures that no important factor is omitted from the analysis. In most cases the lists do not give any guidance on how the impacts on the environmental factors should be assessed or the type of predictive technique to be used. Table 2 shows an example of a simple list. It shows both the development actions and environmental features.

Table 2.

Environmental list for attributes potentially affected by residential development.

Actions	Environmental and socio-cultural characteristics and conditions
Modification of regimes	Physical & chemical characteristics
Alteration of groundwater	1. Earth
Modification of terrestrial habitats by new surfaces	Seismic characteristics
Exotic flora introduction	Construction materials
Introduction of cars	Soils
	Land form
Land transformation and construction	2. Water
	Surface water quality
Land clearing	Surface water quantity
Highways and bridge const.	Underground water quality
	Recharge of aquifers

Roads, rails etc
New surfaces
Resettlement of displaced people

Salinity

3. Atmosphere
   Quality
   Climate

4. Processes
   Erosion
   Deposition
   Compaction and settling
   Stability (slides, slumps)

Cultural factors
1. Land uses
   wildlife habitat and preserves

ii) Descriptive checklists.

This approach gives guidance on assessment. Each environmental factor is provided with appropriate measurements. Table 3 shows a list with the measurements.The section on preferred measures describes the type of indicator that can be used to determine an impact. Fall back measures could be the various facets of the peferred measure which can be used to bring out more information on the impact. The section 'usually applicable to evaluation' shows the various project activities which will be affected by a particular measure. The bases for estimates refer to the nature of the actual data that will be required and the references are the areas that will be affected. Human concerns are also related to the impacts in this approach. The people to be affected are considered by this method.

iii) Scaling lists

This approach incorporates the concept of the 'Threshold of Concern.' (TOC). This is a value which is used to determine the significance of the environmental impacts arising from alternative project actions. The approach consists of the environmental factors and the criteria expressing the desirable values of the factors. Table 4 shows a typical example of the threshold approach. The environmental features are listed in the left hand column. The TOC refers to the acceptable value of the factor that will have been used. In the example the criteria used for water quality is 3% dissolved oxygen as the threshold. If the project under consideration results in an increase in the value of this factor to above the TOC, it may result in better quality water, than if the level fell to below the TOC. The same can be said about endangered species. The same dam construction project at a particular site may result in a reduction of the rhino species due to increased poaching. The TOC of this is 35 pairs. If this project results in them falling to below this figure, an alternative site where they do not fall to below the TOC may have to be selected. All the environmental factors are subjected to this for the various alternatives and the alternative with the best values for the TOC

SUGGESTED IMPACT MEASURES

IMPACT AREA AND SUBAREAS		USUALLY APPLICABLE TO EVALUATING			
Preferred Measures	Fallback Measures	Comprehensive Plans Cumulative Effects, Large Rezoning	Small to Meduim		BASES FOR ESTIMATES REFERENCES
			Residential Rezoning	Commercial-Industrial Rezoning	
1 Local Economy Public Fiscal Balance 1. Net change in governemnt fiscal flow (revenues less expenditures).		x			Public revenues:expected household incomes by residential housing type: added property values. Public expenditures: analysis of new service demand; current cost: available capacities by service. M
Employment 2. Change in numbers and percent employed, underemployed, by skill type.	2a Number of net new long and short-term jobs provided to local area.	x		x	Direct from new business or estimated from floor space, local residential patterns, expected immigration, current unemployemnt profiles.
Wealth 3. Change in land values.		x	x	x	Supply and demand of similarly zoned land, environmental changes near property.
1. Natural Environment Air Quality Health 4. Change in air pollution concentrations by frequency of occurrence and number of people at risk.	4a Change in air pollutant concentrations relative to standards 4b Change in populatant emissions relative to emission 'budget'[5] or 'targets.	x		x	Current ambient concentions, current and expected emmisions, dispersion models, population maps. K
Nuisance 5. Change in occurrences of visual (smoke, haze) or olfactory (odor) air quality nuisances, and number of people affected.[6]	5a Changers in the likehood that air quality nuisances (qualitative judgement) will occur or vary in severity.	x		x	Baseline citizen survey expected industrial, processes, traffic volumes. K,C
Water Quality 6. Changes in permissible or tolerable water uses and number of affected-for each relevant body of water.	6a Change in water pollutant concentrations (relative to standards). for each water pollutant. 6b Change in amount discharged into body of water relative to effluent "budgets" for each pollutant.[5]	x		x	Current and expected effluents, current ambient concentrations, water quality model.
Noise 7. Change in noise levels and frequency of occurance, and number of people bothered.[6]	7a Change in traffic levels, sound barriers, and other factors likely to affect noise levels and perceived satisfaction.	x	x	x	Changes in nearby traffic or other noise barries; noise propagation model or monographs relating noise levels to traffic, barriers, etc. baseline citizens survey of current satisfaction with noise levels. K,

Source: O'Riordan (1983)

Table 4: Threshold of concern worksheet with sample elements, criteria, thresholds of concern, and impact data

Element	Criteria	Threshold of Concern (TOC)	Alternative 1 no action		Alternative 2 median investment		Alternative 3 high investment	
			Impact and duration	Impacts >TOC?	Impact and duration	Impacts >TOC?	Impact and duration	Impacts >TOC?
Air quality	State guidelines	3	4C	Yes	4C	Yes	4C	Yes
Economics	Efficiency (benefit cost ratio)	1:1	3:1	No	4:1	No	4.5:1	No
Employment	Private sector jobs	Present level	9,000C	No	9,500C	No	10,000C	No
	Forest service manpower requirements	Present + 10%	400C	No	440C	No	500C	Yes
Range resources	Animal unit months provided	Present level	5,000C	No	5,000C	No	3,000C	Yes
Recreation	Number of dispersed camping sites	5,000	2,800C	Yes	5,000C	No	6,000C	No
	Winter sports (visitor days)	1,000,000	700,000C	Yes	1,00,00C	No	2,000,000C	No
Threatened and endangered wildlife species	Number of spotted black rhino	35	50D	No	35D	No	20D	Yes
Water quality	State water quality standards	3	3C	No	C	No	4C	Yes
Wildlife	Viewing elephant and lion	25% decrease in population	10%C	No	10%C	No	30%C	Yes

Source: Sassaman (1981) in O'Riorden (1983)

is selected.

A time dimension over which the impacts are going to be felt has been used with this approach. For each impact a letter is added to the value of the factor as shown in table 4. The scale shown below is used for the time:

A	= 1 year or less	C	= 10 - 50 years
B	= 1 - 10 years	D	= irreversible

Projects with impacts which are going to be felt over longer periods of time are going to be discarded. Ultimately the actual factors under consideration will determine whether a particular alternative is going to be implemented or not. It is the alternative with the least overal negatively skewed impact values from the TOC which is selected.

iv) Questionnaire checklists

This approach was developed by USAID to assess rural development projects in developing countries. The method relies on a number of questions being asked about the likely impacts of projects on the environment. The questions are divided generically into categories as is shown in table 5 - terrestrial ecosystems, disease vectors etc. Questions in all categories must be answered and there are only three possible answers. It can either be a 'yes' if the

Table 5 Example of questionnaire checklist

Terrestrial ecosystems

a) Are there any terrrestrial ecosystems of the types listed below which by nature of size, abundance or type, could be classified as significant or unique?			
Forest?	Yes___	No____	Unknown____
Savanna?	Yes___	No____	Unknown____
Grassland?	Yes___	No____	Unknown____
Desert	Yes___	No____	Unknown____
b) Are these ecosystems:			
Pristine?	Yes___	No____	Unknown____
Moderately degraded?	Yes___	No____	Unknown____
c) Are there present trends towards the alteration of these ecosystems through cutting, burning, etc to produce agricultural industrial, or urban land?	Yes___	No____	Unkown____
d) Will the project require clearing or alteration of			
Small areas of land	Yes___	No____	Unknown____

Moderate areas of land? Yes___ No____ Unknown____
Large areas of land? Yes___ No____ Unknown____

Estimated impact on terrestrial ecosystems ND..HA..MA..LA..O..LB..MB..HB

Disease vectors

a) Are there known disease problems in the project area transmitted through vector species such as mosquitoes, flies? Yes___ No____ Unknown____

b) Are the vector species associated with:
Aquatic habitats? Yes___ No____ Unknown____
Forest habitats? Yes___ No____ Unknown____
Agricultural lands? Yes___ No____ Unknown____
Degraded habitats? Yes___ No____ Unknown____
Human settlements? Yes___ No____ Unknown____

Estimated impact on vectors ND..HA..MA..LA..O..LB..MB..HB

Adapted from O'Riordan, 1983.

ecosystem or the environmental factor under discussion is going to be affected, a 'no' if not, or 'unknown' if it is not certain as shown above. If it is unknown then more research will have to be carried out to provide the necessary data for the question to be answered.

Ultimately an attempt to assess the net impact for each generic category is done by classifying the impacts within each category according to whether they are beneficial or not on the scale shown below.

ND	-	not determinable.
HA	-	high adverse
MA	-	medium adverse
LA	-	low adverse
O	-	low or insignificant
LB	-	low benefit
MB	-	medium benefit
HB	-	high benefit

If that particular category is going to be adversely affected, then other alternatives have to be worked out in order to minimise the adverse impacts. If the impacts are highly adverse, then the project may have to be abandoned.

vi) <u>Overview</u>

The questionnaire approach is generally applicable during the

initial stages of assessment. During this stage they act as a guide ensuring that all vital factors have been included in the assessment exercise. However, they have the weakness that in most cases they do not consider the secondary impacts of project actions. They largely focus on primary impacts and this may result in misleading interpretations. They also do not bring out the project actions responsible for the impacts on the environment.

3.3.2 MATRICES

This is probably the most common method in EIA. This method of using a matrix appears in a number of forms. The common characteristic with this method is that it will employ a list of human actions on one side of the matrix against project actions on the other side. Perhaps the best known is the Leopold matrix which is based on a horizontal list of development actions and a vertical list of environmental characteristics . Fig 4 gives a typical example of the Leopold matrix. This matrix was designed for the assessment of impacts relating to all types of construction projects. Impacts are identified by relating each development action with all the specified environmental characteristics.

Those cells where an impact between a project activity and an environmental component is imminent are marked. This Leopold matrix has a potential for identifying 8 800 impacts. In reality, however a project always produces a limited number of impacts. Leopold also devised a scheme to go with his matrix to indicate the magnitude and importance of the identified impacts. Magnitude is defined as the scale of an impact or how widespread a particular impact is. Importance refers to the significance of an impact and in most cases this seen in terms of whether an impact is reversible or not. It is the irreversible impacts which will have the greatest significance.

For this to be realised each cell is divided diagonally as in fig 4 (insert). The significance and magnitude are then ranked on a scale of 1 - 10 indicating increasing magnitude or importance. The upper left hand corner then indicates magnitude and the lower right hand corner the importance. If an impact is beneficial a (+) sign is put before each number to denote beneficial impact. Some projects may have high magnitude impacts but on factors with very low significance. It is those environmental factors which will have been identified during the scoping exercise which have to be given special attention as far as the analysis is concerned. Discussion will then focus on those cells with large numbers.

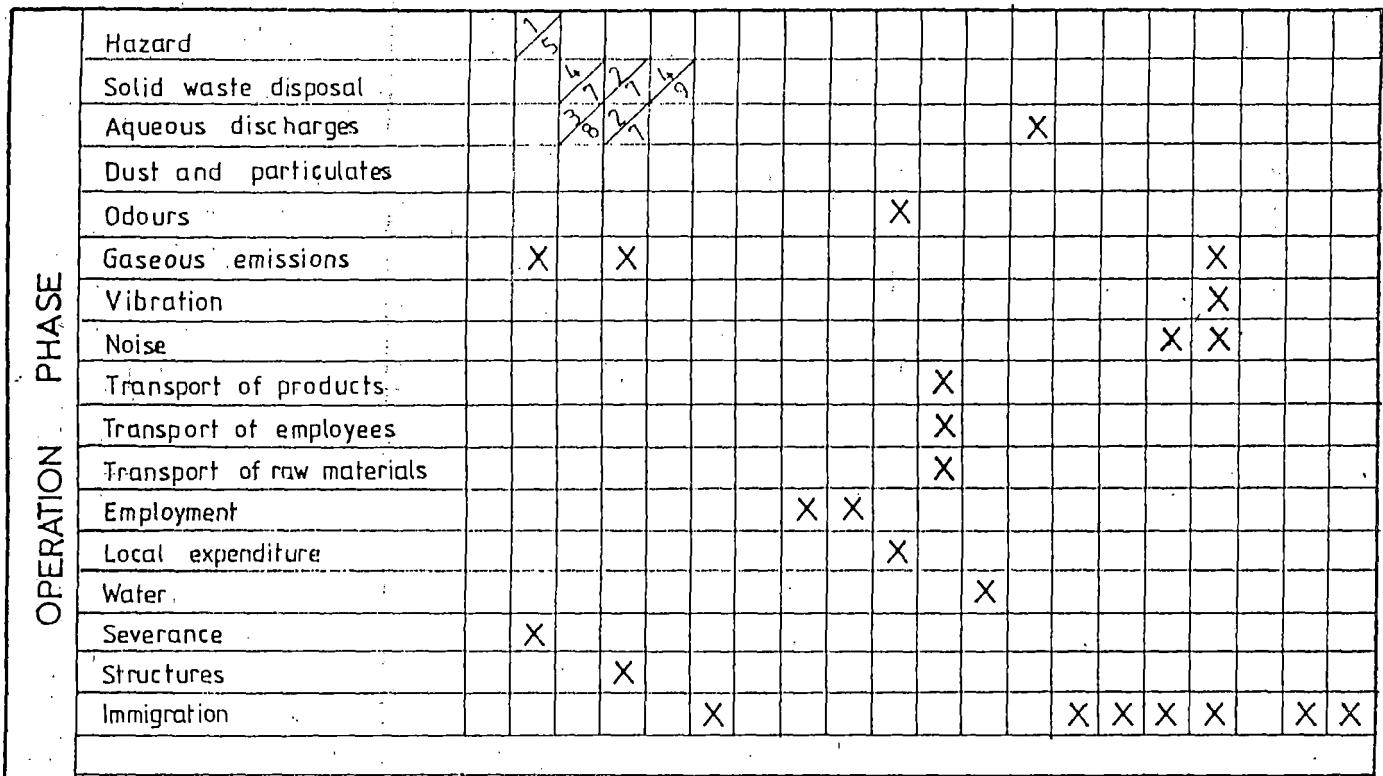
Advantages of the method.

1. The Leopold matrix provides a comprehensive reference list of possible impacts. All possible impacts on the physical environment are included in the matrix. This means that it is difficult to leave out any factors when this method is used.
2. It is also a good visual tool. It is easy to get a visual

CHARACTERISTICS OF THE EXISTING SITUATION	CONSTRUCTION PHASE															
	Immigration	Severance	Transport of raw materials	Transport of employees	Site preparation	Dust and particles	Employment	Local expenditure	Water demand	Vibration	Noise	Gaseous omissions	Odours	Aqueous discharges	Solid waste disposal	Hazard
Climate																
Land uses		X														
Water quality					X	X								X		
Landscape quality					X									X	X	
Ecological characteristics																
Population density																
Tourism																
Employment structure							X									
Unemployment structure							X									
Local economy								X								
Traffic			X	X												
Water supply									X							
Sewerage																
Finance	X															
Education	X										X					
Health service facilities	X															
Housing	X									X	X					
Community structure	X															
Culture	X															

Source : Clark et al (1981)

Figure 4 : Example of an impact assessment matrix



summary linking the factors from the cells.

Disadvantages.
1. Complexity of cells. Although the list of components is extensive, some are too broad for adequate impact appraisal. eg soils or vegetation will need more research.
2. It focuses only on first order impacts and the secondary impacts are not taken into account. These may prove to be important eg the relationship between soil fertility and agricultural productivity.
3. The derivation of the numerical component is very subjective. This makes it difficult to compare studies since different people are bound to come up with different derivations.
So other methods were developed.

3.3.3 THE SPHERE MATRIX

This type of matrix got its name from the name of the consulting company that first used it. The principle behind this matrix is similar to the Leopold one. However, this type of matrix compares potential sites to be used by a project on the identified environmental factors to be affected by project actions. The sites are listed horizontally while the environmental and socio-economic factors applicable to all sites form the vertical component. In most cases this method is used when it is known that a project will affect all the environmental factors and the site where the factors are list affected is the one selected.

The impacts are ranked on a subjective scale of 0 - 5 where 0 is good and 5 is bad. (see table below.)

Table 6 : Sphere matrix

	SITES			
FACTORS	A	B	C	D
1.Visual Intrusion	2	4	1	2
2.Landuse destroyed	2	2	5	5
3.Houses directly affected	1	2	4	0
4.Road access	4	0	0	3

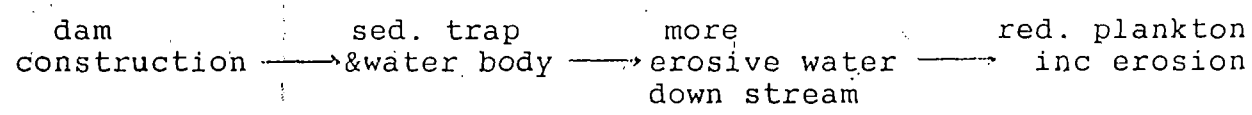
The ranked score for each column can be weighted according to how each factor is viewed in terms of importance. It is then the summation of the weighted scores which will determine the suitability of a site - The site with the lowest score in most cases.
The main disadvantage with this method is just like in the Leopold matrix ie its subjectivity. Scores/ranks are derived subjectively. Some of the factors used are too broad only give a general picture.

3.3.4 NETWORKS and FLOW DIAGRAMS

These try to incorporate the indirect impacts of projects. Most matrices do not have the facility to look at these indirect impacts. The network approach was first developed by Sorensen[1] who used a combination of matrices and networks. (Fig 5)
The network was first applied to various landuse options like residential or crop farms. The development actions are linked to condition changes or the environmental effects relating to environmental components. As is shown in fig 5, the method can describe third-order changes from the initial, consequent condition and the effect. The method can also deal with the post-development situation and tries to look for corrective action. There are two important questions asked at each stage. Firstly, is an identified condition change going to induce a further condition change? Secondly , is the additional change sufficiently significant to warrant inclusion in the network?

At times simple flow diagrams have been used to identify impacts. These merely trace flows of impacts between action and environmental components with direction of flow showing the direction in which the changes are taking place in (see below)

Flow diagram showing impacts



MAN'S ACTION EFFECTS

Adapted from Munn, 1979.
There has also been an attempt to computerise the network approach. This has been made possible by a programme known as IMPACT. This programme has been developed largely to take care of developments in forest and rangeland areas. For one to use this programme it is only necessary to have some knowledge of the characteristics of a proposed development. The computer can then do the rest in terms of supplying information on the chain effects likely to arise if a particular activity was undertaken.

Networks have been criticised for their inability to provide information on impact characteristics such as probability, importance, and magnitude. However this information can be provided using the other methods or on a computer. The main advantage of this method is making sure that all the possible direct and indirect impacts have been investigated.

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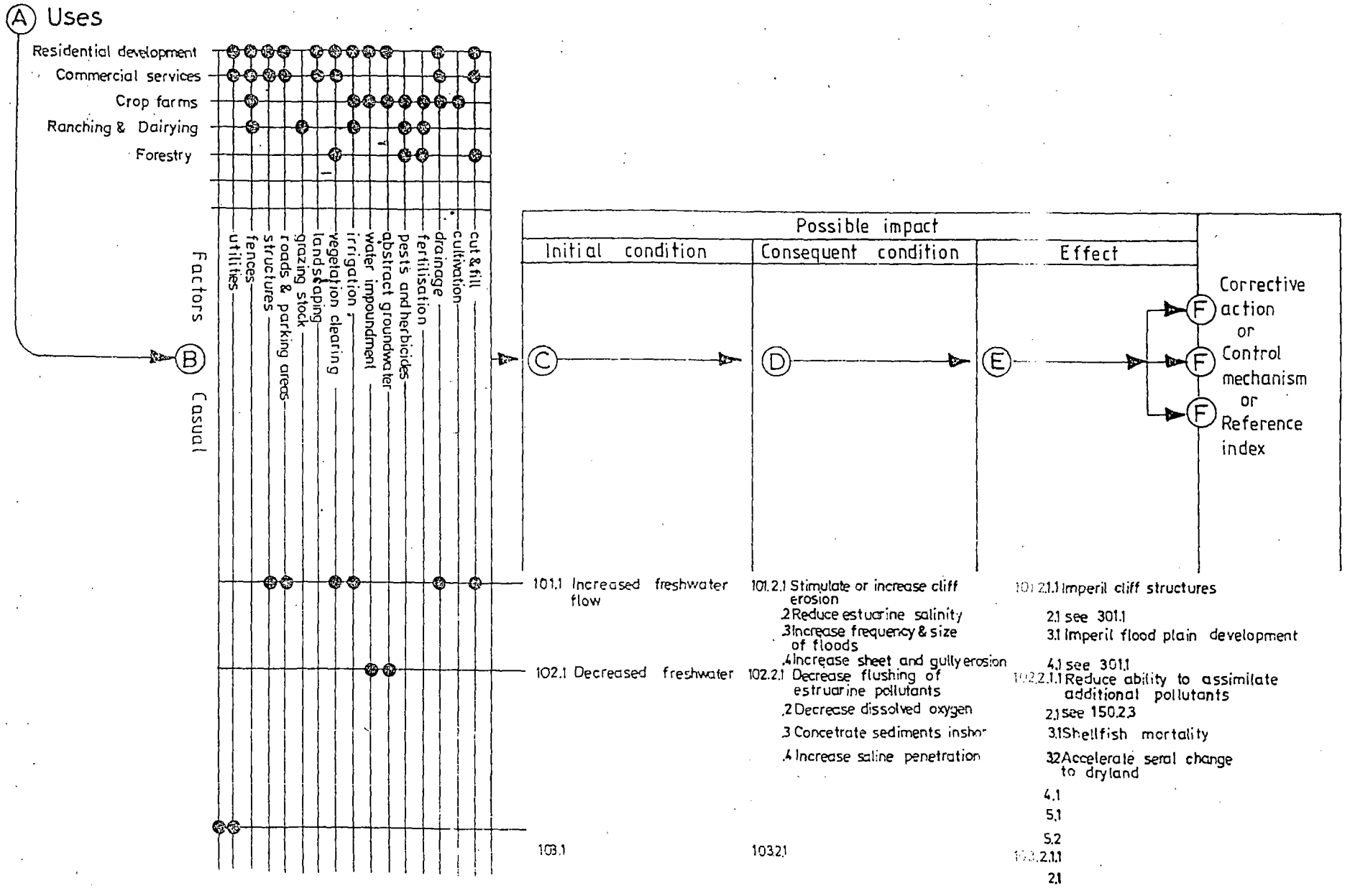
1. Sorensen, quoted in Munn, RE (1979) Environmental Impact Assessment: Principles and Procedures. John Wiley & Sons, London.

Figure 5 Section of the Sorensen network



Source Adopted from Sorensen (1971)

3.3.5 QUANTITATVE / INDEX METHODS

These methods have resulted from the need to devise methods capable of comparing the relative importance of all impacts. This has been made possible by weighting , standardising, or aggregating the impacts so that ultimately a composite index for either beneficial or harmful impacts or alternative project designs is produced.

Perhaps the best known of the quantitative methods is the Environmental Evaluation System (EES). This method was devised for assessing water-resource developments. Seventy-four environmental and socio-economic parameters were used initially. The assumption is that these parameters can be expressed numerically and be related to the quality of the environment. A good example here is that of oxygen which can be expressed in ml/g. It is the concentration of dissolved oxygen which determines the quality of an aquatic environment. The more dissolved oxygen there is in the particular environment, the better quality it is . All other parameters are also assumed to have a similar relationship as far as the quality of the environment is concerned. eg humus content and fertility of the soil.

The environmental quality for each parameter is then subsumed on an arbitrary scale of 0 - 1, where (0) is a degraded environment and (1) is a high quality one. The next stage is that a group of experts then assign/design value functions for each parameter. (Fig 6). These value functions relate to the relationship between environmental quality and the particular parameter. eg the carrying capacity for browsers of a particular environment is known. There will be deterioration in quality if that capacity is exceeded. On the other hand if the carrying capacity is below the optimal range , then the quality improves as the environment is being under utilised. Fig 6 shows that when approximately 50-60 % of net annual above-ground production of plants is consumed, no damage occurs to the environment. It is when consumption is above this capacity that damage occurs. So when consumption is below optimal, the full grazing potential of the system is not used and quality remains high eg at 40% quality is 0,8.

To allow for comparison directly, each parameter is weighted by distributing 1000 points amongst the parameters. This is done the group of experts using the Delphi technique. The points are distributed on the basis of the viewed importance of the parameter in the project. After the weights have been distributed and the impact scores normalised on the 0 - 1 quality score impacts can then be compared and aggregated. Two scores are important for this exercise - the current state of the environment and the predicted state once the project has been operationalised. A comparison of the scores gives an indication of whether the project is going to be beneficial or not. Should the score of the post-development era be less than that of the pre-development stage, a negative or a positive impact can be recorded depending on the initial quality of the environment and the parameter under consideration. A

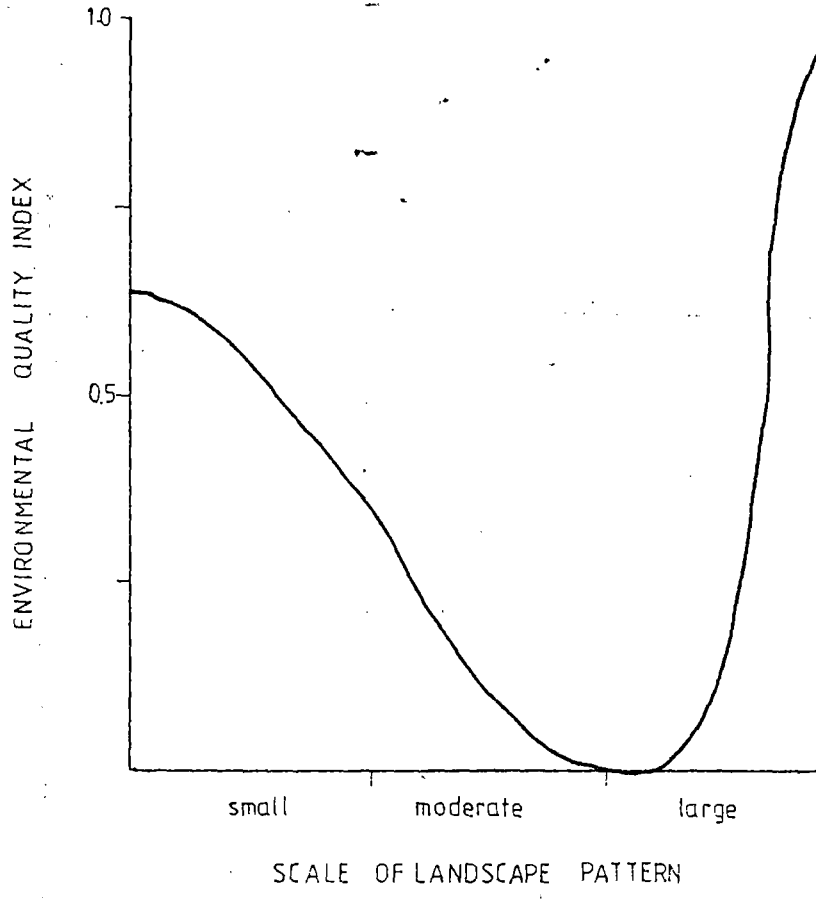
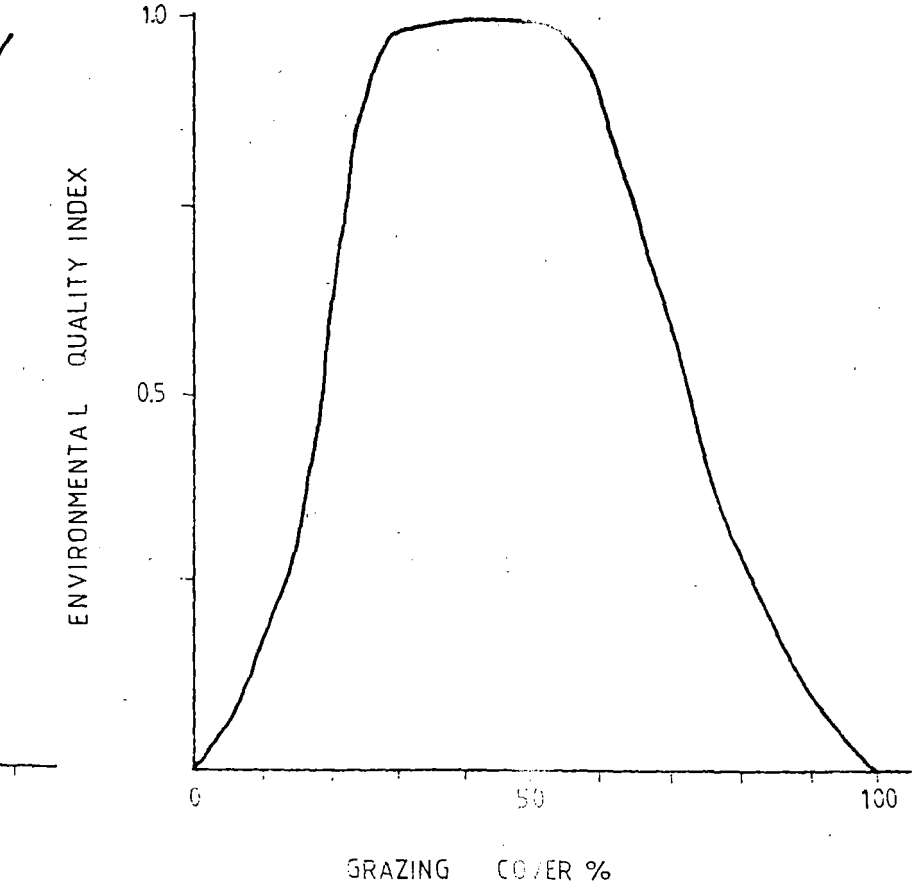


Figure 6 : Hypothetical environmental

SOURCE WA THERN (1988)



quality indicies for range land quality

composite score either for beneficial and adverse impacts can be compiled by adding up individual impact scores.

This approach provides for cases where there is inadequate data. At times the value of an impact indicator cannot be estimated because of inadequate data. More research can be carried out for such situations. The EES approach has also been criticised for treating the environment as if it were made up of discrete units.

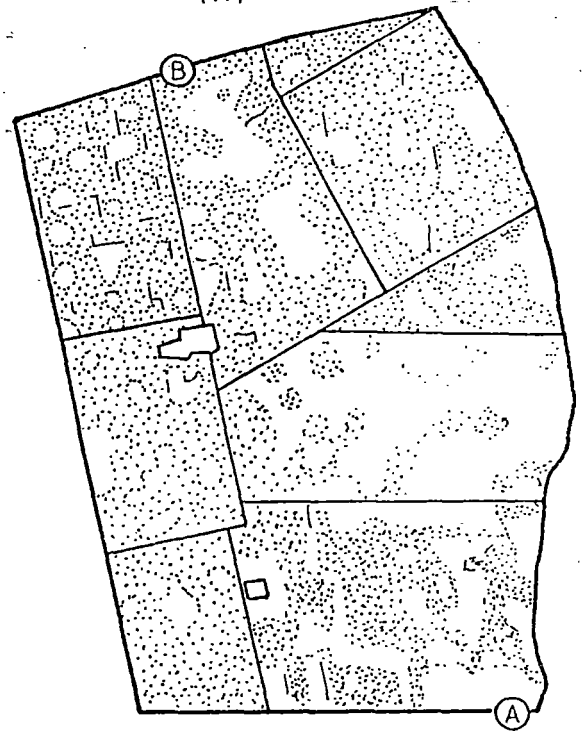
One should bear in mind that impacts are only related to particular factors. The method relies on the assumption that information on impacts can be reduced to numbers. Information losses may occur during this process and it is also difficult for the lay people to fully comprehend this method. The method can also be open to abuse when those who assign the values deliberately manipulate these by changing assumptions. (Bisset, 1978).
However this method is good in terms of providing quantitative information which can be very useful in impact assessment. This can save decision makers from wasting valuable time trying to interpret results when faced with a descriptive approach to impact assessment.

3.3.6 OVERLAYS

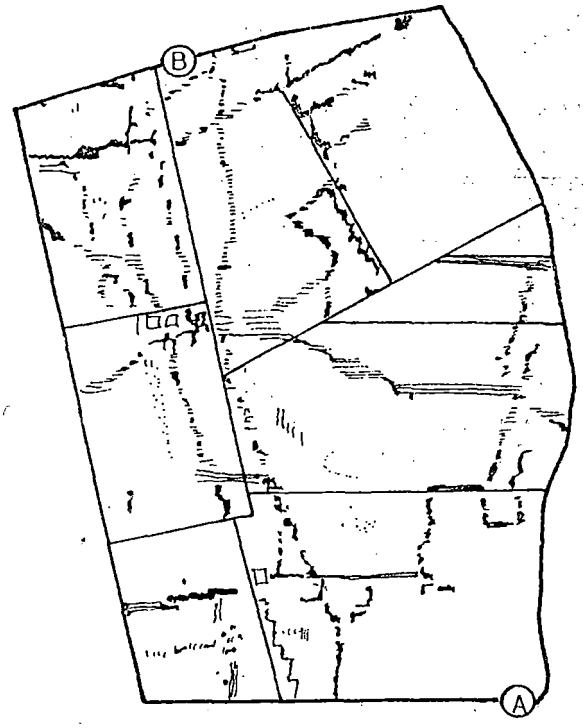
This method tries to place impact assessment in its spatial context. The method is good in pin-pointing the areas which will be affected by a particular project. It relies largely on the use of transparencies which according to Munn, are used to 'identify, predict, assign relative significance to, and communicate impacts in a geographical reference frame larger in scale than a localised action would require.' So this is a method which is useful where the anticipated impacts will be felt beyond the immediate location of the project.

The area under consideration is divided up into geographical units, in most cases uniformly spaced grids,or differing landuses are used. It is on the basis of these grids that information on the various environmental factors is collected. In most cases the information is collected through aerial photographs, topographical maps, field observations and/or public discussions with experts or locals. A series of maps (transparencies) are then produced, each one based on a factor. The maps will be showing the extent of the area to be affected as far as each factor is concerned. At times the magnitude of the impact can also be shown by shading techniques, with intensity of shading corresponding to the intensity of the potential impact. (see fig 7).These factor maps can then be overlayed to find the most suitable areas where there is least disruption of the environment and land uses are suitable. Computers can be used to determine the impacts within each area by aggregating maps.

Both qualitative and quantitative data can be incorporated in this method. The shading technique can be used to quantitatively depict

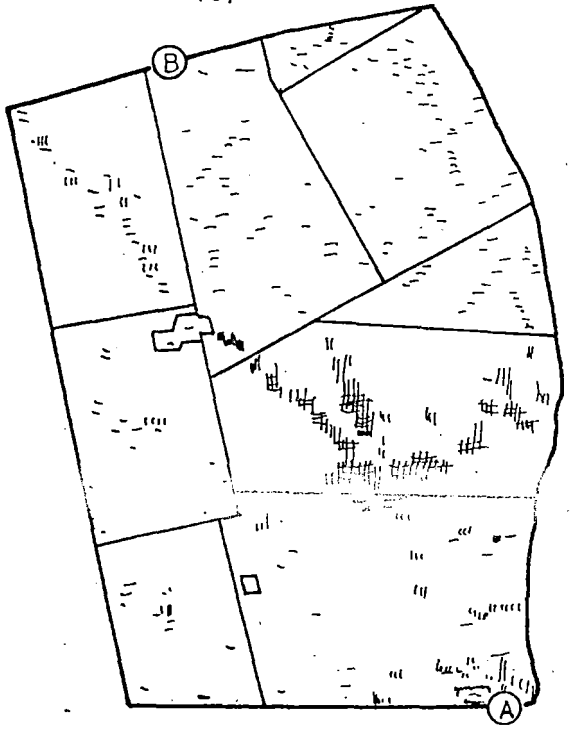


Agricultural impact



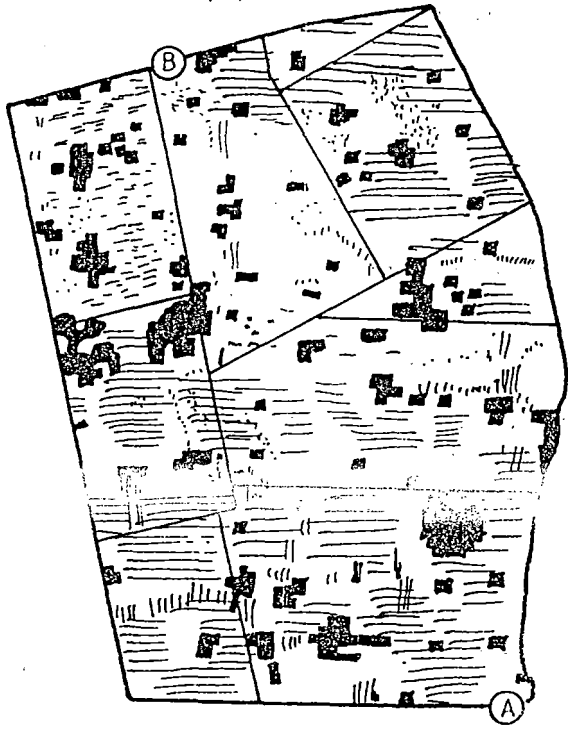
Linear impact

(C)



Visual impact

(D)



Compcsite impact

Source Adpted from Munn (1979)

Figure 7: Overlay Method

impacts. Fig 7 referred to above shows that some the impacts decrease with distance from the source. There is a limit to the number of overlays which one can have at any one time. In most cases it is not possible to have more than 10 overlays at once without suffering from loss of clarity. It becomes too messy to try and handle too many overlays. In the end the product will not be good if there are too many overlays at the same time.

3.4 CHOOSING A METHOD

The choice of a method to use for impact assessment will depend on a number of variables. Ideally the best method is the one which is able to deal with impacts in being able to identify and quantify the impacts and also communicate the impacts to decision makers and the public easily. However besides these primary considerations, there are also other factors which are important in determining the choice of a method. These relate to the resources available (financial and manpower), time, and additional facilities which may be required by a method.

1. Resources.

One should have sufficient resources, both financially and manpower wise to be able to mount an EIA. To carry out an EIA requires money to finance the many activities that are involved in the EIA exercise. This means that the person carrying out this exercise must have the money. Within the Third World there are other development activities which are deemed to be important. So EIA becomes another cost and this becomes a difficult cost to bear especially for Third World countries where there is competition for these resources with other users. Methods commonly used are the quantification and to a lesser extent the matrices and the overlay method.

The manpower situation is also crucial. Some methods rely too much on experts in a number of issues. These experts may not be available and it becomes difficult to do a thorough job if a method relying on these experts is selected. The best therefore is to go for the simple methods like the Leopold matrix or the overlay approach which do not rely a lot on experts or specialised manpower.

2. Time.

The time factor is important. With limited time available it may be necessary to go for the simple methods. The network approach is quite complicated and has elements of both the matrix and flow diagram approach. So maybe the easily carried out methods are better from the time point of view.

3. Additional facilities.

As is already clear from the above discussion, some methods require the use of computers. The cost of this facility may be an extra cost and besides the right type of machine may simply not be available. So the easier methods which do not rely on computers may

be desirable.

However there is a price to be paid for the selection of the simplest methods. Firstly the simple method may not be the best in terms of unravelling all the environmental impacts. The Leopold matrix ignores secondary impacts. In most cases a limited amount of information will be available from most of the methods and may be to use a combination of methods would be the best way out. Secondly in terms of communicating the results to the users and decision makers, some of the methods may not be the best. So the various methods have to be compared against a number of factors before one or a combination is selected for a project. The issues to be considered include:

1. **comprehensiveness**- does the method allow all the elements to be adequately covered? As many environmental factors as possible must be looked at to ensure that even the secondary impacts have been also unravelled.
2. **communication of results** - how easy is it to communicate the impacts to the public and the client? A method must be able to communicate the results to the public without any problems of comprehension.

In most cases not one method is selected, but a combination to allow for the possible coverage of all impacts which may result from a project.'

SECTION 4

4.0 ENVIRONMENTAL SETTING AND PREDICTION OF IMPACTS

4.1 Purposes of Defining environmental setting

Since ultimately the purpose of EIA is to determine impacts on the environment, it is very important that the environmental set - up is clearly defined from the beginning. This means looking at the existing environmental conditions and seeing how an intended project will change these conditions. So ideally there should be a definition of 3 sets of states:

a) initial reference state.
b) estimate of future state without action.
c) estimate of future state with action.

It is only from a description of these environmental states that one will be able to compare and come up with a conclusion as to the likely impact of a project on the environment.

a) Present state

As Munn (1979) put it, the act of EIA presupposes knowledge about the present state. It becomes very important for EIA to have certain attributes which can be used to measure or estimate the present state of the environment. These selected attributes can be measured in terms of quantities or certain qualities which they possess or be ranked in order of magnitude. It is very difficult to fix the statistical population of an attribute which will be representative. So one has to be very careful in terms of selecting the proper environmental indicators which correctly describe the present or initial state of the environment.

b) Future state without action

This state has to be described because of the realisation that there are always some changes that do occur within the environment naturally. As a result of these natural changes certain species or the quality of the environment may be declining before a project is introduced into an area. This is a very difficult state to describe as there will always be uncertainties surrounding the behavior of biological systems. So the decision maker has to be aware of the degree of uncertainty surrounding a particular environment.

c) Future state with action

This is a scenario of the environment that will result after the project has been introduced. This state can be derived from the various methods that have already been described. It is then a comparison of these three states which would establish the severity of an impact, depending on how the new environment will be adversely affected from the original state .

In most cases one is interested in the type and rate of changes in the following main environmental elements ;

SOIL	Quality (eg depth, structure, fertility, degree of salination or acidification, stability Area of arable land.
AIR	Quality Climatic elements.
WATER	Quantity Quality Seasonality Area of man-made lakes. Extent of irrigation.
BIOTA	Abundance/scarcity of species Extent of crops, ecosystems, vegetation and forests. Diversity of species Extent of provision of nesting grounds, etc of migratory species. Abundance/scarcity of pests and disease organisms

Adapted from Munn, 1979.

It is imperative that a list of environmental factors be developed. Most Third World countries suffer from lack of data on the environment. So there is need to systematically collect data on various facets of the environment which can then be used for purposes of impact assessment or any other function that may require detailed knowledge of the local environment.

4.2 PREDICTING IMPACTS

It is difficult to come up with a method that is capable of predicting all possible environmental impacts of a development project. Where an impact is predicted it is very important to analyse the importance in magnitude of the potential changes which may occur. The analysis should not end at detailing how that impact will affect the environment only but should also predict the extent to which the impacts may impose constraints on development during constructional and developmental stages. This is important for design or layout modifications which would be necessary before planning permission is granted.

There are specific techniques which can be used to assess impacts like noise, soil erosion or concentration of pollutants in the air, water or ground. AN assessment of each impact should be made to determine whether it would be:

1. beneficial or adverse,
2. short term or long term,
3. reversible and/or irreversible.
4. direct and/or indirect,

5. local and/or strategic

Adapted from Clark et al, 1979.

Information to determine the above must be provided in quantified form as much as possible.

4.3 ASSESSMENT TECHNIQUES.

Whereas methods identify impacts, techniques actually provide the data that will be used in the methods. The choice of a technique to use will in most cases depend what environmental facet is to be evaluated. Some of the main areas where different evaluation techniques are used are:

1. Ecological evaluation.
2. Landscape evaluation.
3. Socio-economic evaluation.

4.3.1 Ecological Evaluation Techniques

This is dependent upon certain characteristics of an ecology. These relate to extent, diversity, naturalness, rarity, fragility, representativeness, research and educational value of system, recorded history, position in ecological series, and potential value of the particular ecological system. All this information can be provided in quantitative or qualitative form. Diversity can be dealt with by counting the number of different species, and fragility can be dealt with by using certain indicators like proneness to erosion as a result of soil type. Land capability classifications can be used to determine the nature of an ecosystem and how it will behave under a particular landuse. The data that will have to be gathered here will relate to :

a) agricultural areas and sites for this activity.
b) amount of unsown vegetation in area.
c) plantation and woodland areas.

The areas which have been devoted to the above uses can be computed and then be compared to the capability potential of that area. This can then give an indication of whether the area is being under utilised or not. The other parameters like the ecological history can be dealt with in a qualitative fashion by descriptions. Sites which are deemed to be of special consideration eg fragile sites or those with greater developmental potential for development can be mapped out with the view to being avoided or to channel development to these areas.

Major ecological changes are likely to take place in the form of

1. Physical destruction of habitat.
2. Air pollution.
3. Water pollution.
4. Changes in direction and/or volume of stream flow.
5. Ground water changes.

6. Management changes.
7. Increased recreation pressure.
8. Erosion
9. Animal disturbance.

An assessment should therefore be on the significance of each potential impact.

4.3.2 Landscape Evaluation

Physical evaluation techniques in most cases rely on the interaction between the physical components of a landscape and a range of personal emotional responses induced by it. The techniques for evaluation will differ in most cases on the basis of the concept of landscape as art as influencing not only the measurement and evaluation of the physical components but also emotional components. The approach is to divide the evaluation exercise into two. The first phase is that of classifying the area to be affected into landscape types. The second phase consists of an assessment of the comparative value of the different landscapes.

The classification of area into land scape types is largely on the physiognomy of the land and landuses in the area eg valleys, mountainous areas and agricultural and residential areas. The assessment of the value of the landscape is largely aesthetic and will be based on vegetation types, water bodies in area, or slope facets. Assessors can be used to assess sites where development is going to occur. They can then classify the existing and the future value of the land with development on a score sheet as shown below:

0 - 1	unsightly
1 - 2	undistinguished
2 - 4	pleasant
4 - 8	distinguished
8 - 16	superb
16 - 32	spectacular

The scoring is on the basis of analysing landscape components - topography, landuses, scale of features, vegetation, buildings - architectural unity, water bodies, detractors like power lines and lastly trespass (distance to built up areas). If the development is going to result in an unsightly landscape then it can be avoided or some means of making it sightly can be worked out. Mitigating means can be introduced to harmonise development with the landscape.

4.3.3 Socio-economic Techniques

Dixon et al, 1988, have extensively exhausted the techniques which can be used for EIA to take into account the socio-economic implications of projects. They start by relating neoclassical welfare economics to the welfare society and then relate this to environmental impacts of projects. This section will briefly look at some of the techniques which can be used to consider socio-economic issues in EIA.

In most cases the important issue is looking for impacts on the environment that result in changes in productivity that can be valued using market values. A project cab disrupt an agricultural activity based on a particular crop which was the mainstay of the community. This change can easily be computed by looking at the tonnage loss from maize production. This can then be multiplied with what the people are getting now on the open market per tonne. This way one can convert a loss into its monetary value.
Another issue which Dixon brings out is the symmetry in benefits and costs - a benefit forgone is a cost and a cost avoided is a benefit. These costs and benefits should be valued. At times it may be difficult to get market values for some of the benefits and costs. A technique of deriving these indirectly using surrogate market values can be used. Here market prices of substitute or complimentary goods are used to value an unpriced environmental good or service eg clean air which may be seen in the price of houses or land.

The actual techniques which are applicable for taking socio-economic issues into consideration can be divided into two broad groups, ie those that use the market value of directly related goods and services which are :

i) changes in productivity approaches,
ii) loss-of-earnings approaches,
iii) opportunity-cost approaches.

The second group are those techniques that use direct expenditures;

i) cost-effectiveness analysis,
ii) preventive expenditures.

To apply the above techniques the project first undergoes the normal valuation exercise. This is done to establish or compare the costs and benefits of the project. Three methods are used for this purpose; the internal rate of return(IRR), the benefit cost ratio (BCR) and the net present value (NPV). The projects are evaluated over an appropriate time horizon and the formular for calculating these are covered in any basic economic text and it is not necessary to go into the details here. Basically the NPV of a project determines the present value of benefits by discounting the streams of benefits and costs to the beginning of the base year . The IRR is the rate of return on an investment which will equate the present value of benefits and costs and is the discount rate that will result in a zero net present value for a project. The BCR

compares the discounted benefits to discounted costs. If the B/C ratio is exactly equal to 1 ,the project will produce no net benefits over its life time - the discounted benefits just equal the discounted costs. A B/C ratio of less than 1 means that the project generates losses from an economic perspective. The thing to note is that the introduction of the socio-economic dimension in EIA relies heavily on cost-benefit analysis. The use of resources and the quality of the environment are seen as factors of productivity. Changes in any of the two will be reflected in changes in the prices of the commodities produced.

4.4 REPORT WRITING AND THE PRESENTATION OF RESULTS.

Results from the analysis of various impact identification and assessment studies must be drawn together in the form of an impact statement. This statement will describe each impact briefly and assess it in terms of whether it is beneficial or adverse, short term or long term, reversible or irreversible , direct or indirect, and local or strategic in importance. It must conclude by suggesting mitigating measures or advising a rejection of the project on environmental grounds.

The report must have the full description of likely impacts and it must have an appendix showing:

i) technical reports.
ii) summaries.
iii) consultations held and
iv) those impacts which have no mitigating alternatives/measures.

Since this report is not only for the consumption of the decision maker only but also the public at large, care must be taken to make sure that the report is straight-forward and to the point. The use of technical and biological terms should be avoided as much as possible. Only simple language which the public can understand should be used as much as possible. The use of special terms may be viewed with cynicism and be suspected of being a ploy to mislead the public.

The use of visual display material is very important for the report. At times issues become clearer when visual materials are used. It is therefore important that if the public is generally illiterate, visual display materials are used, eg. maps and pictograms. This will help them understand better the issues being discussed. At times some of the visual display methods can vividly portray the situation being discussed. One can take the case of overlay mapping. This method will clearly project whatever areas one may be talking about and the kinds of impacts under discussion.

The results then have to be communicated to the public and the decision makers. This can take the form of public meetings where the information on impacts is communicated back. At times the information is displayed in public places for the people to consume. If there are any queries or clarification , they have to

be raised and attended to before the project begins.

SECTION 5

5.0 INSTITUTIONAL SET UP AND POLICY CONSIDERATIONS

EIA should be tied in with the general environmental policies of a country. For the activity to succeed, there is need for it to have national policies backing it up. This means whoever wishes EIA to be carried out for projects in their area must also have the teeth with which to enforce this requirement. There must be a conscious effort on the part of policy makers to make EIA part and parcel of the whole development network - right from the top to the bottom.

The only way of usefully integrating environmental issues and planning is to legislate EIA as requirement for certain types of projects which are seen to be potentially harmful to the environment. This was done in the USA by the enacting of the National Environmental Policy Act (NEPA). This act made it compulsory for EIA to carried out for most development projects. The responsibility for ensuring that this is done can be given to the local authority. In the USA federal agencies were created to deal with environmental issues. These reported to the Commission on Environmental Quality which was a national body. Some European countries have adopted EIA on a piecemeal basis. They have not enacted EIA but depending on the size and nature of the project can direct that an EIA be carried out.

Most Third World countries do not have proper environmental legislation. There is a lot of conflict as far as issues relating to the environment are concerned. Some of these countries have actually allowed toxic wastes to be dumped in their countries. So it becomes very difficult for one to envisage such countries coming up with legislation to deal with environmental problems. Anyway, hoping that these countries become environmentally aware, they have to come up with legislation which clearly articulates the place of the environment in development. They can then place requirements for EIA to be carried out before any projects are carried out or they can have the permissive approach of insisting on EIA on a project by project basis depending on how each project is seen to potentially damage the environment. This also involves the setting up of the necessary implementing agencies. The local authorities or some similar appointed bodies which have powers to grant planning permission can assume this role. The planning process will therefore assume the form given below. (Fig 8 and 9)

5.1 Other issues to be considered.

There are several other issues which have to be considered when one looks at EIA and developing countries. One of the important issues is that of financing the EIA exercise. Given the very limited financial resources which most third world countries have, it is difficult to envisage them funding such types of activities.

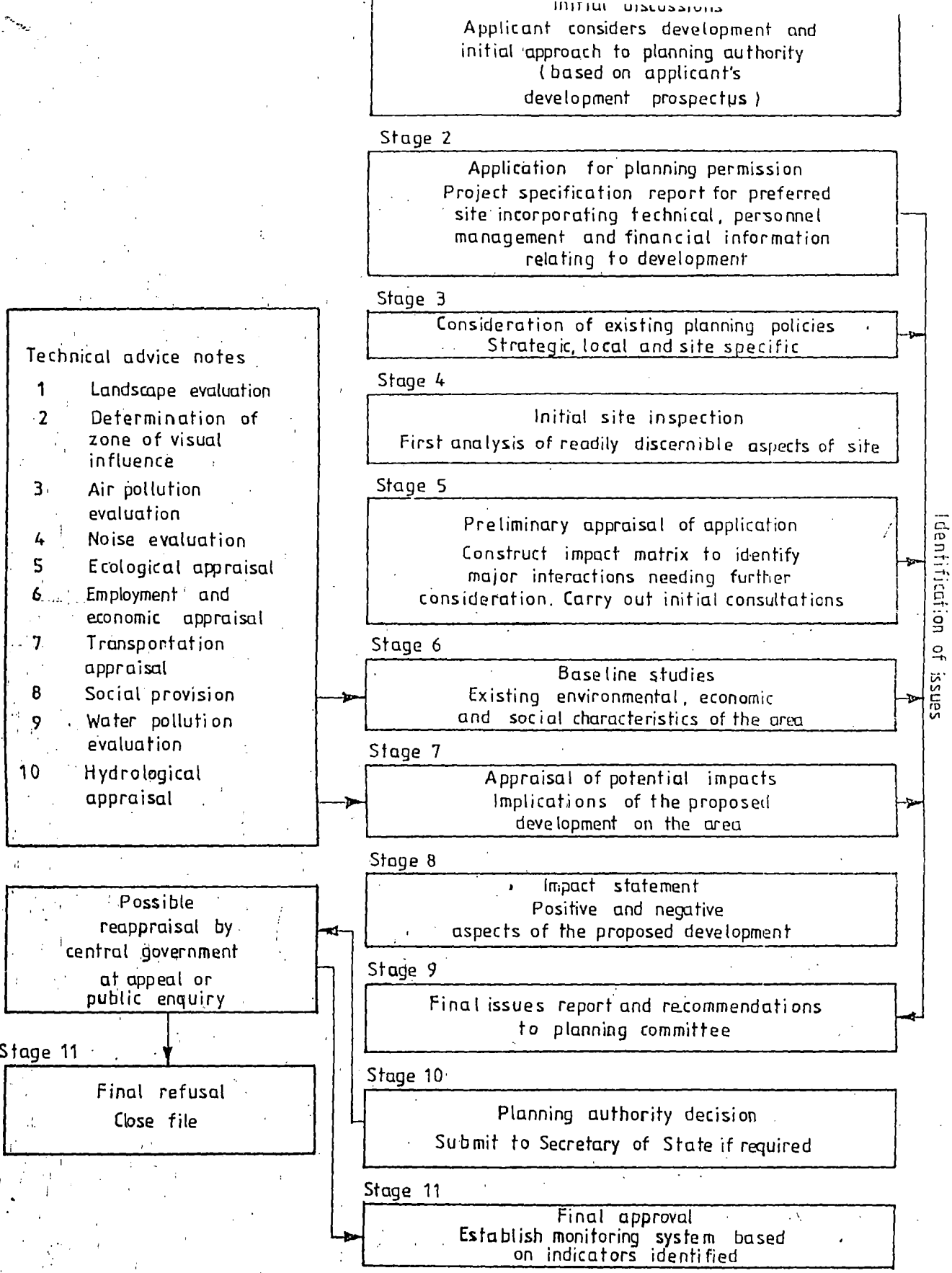


Fig. 8 An approach to project appraisal

SOURCE O Riodan and Hey (1976)

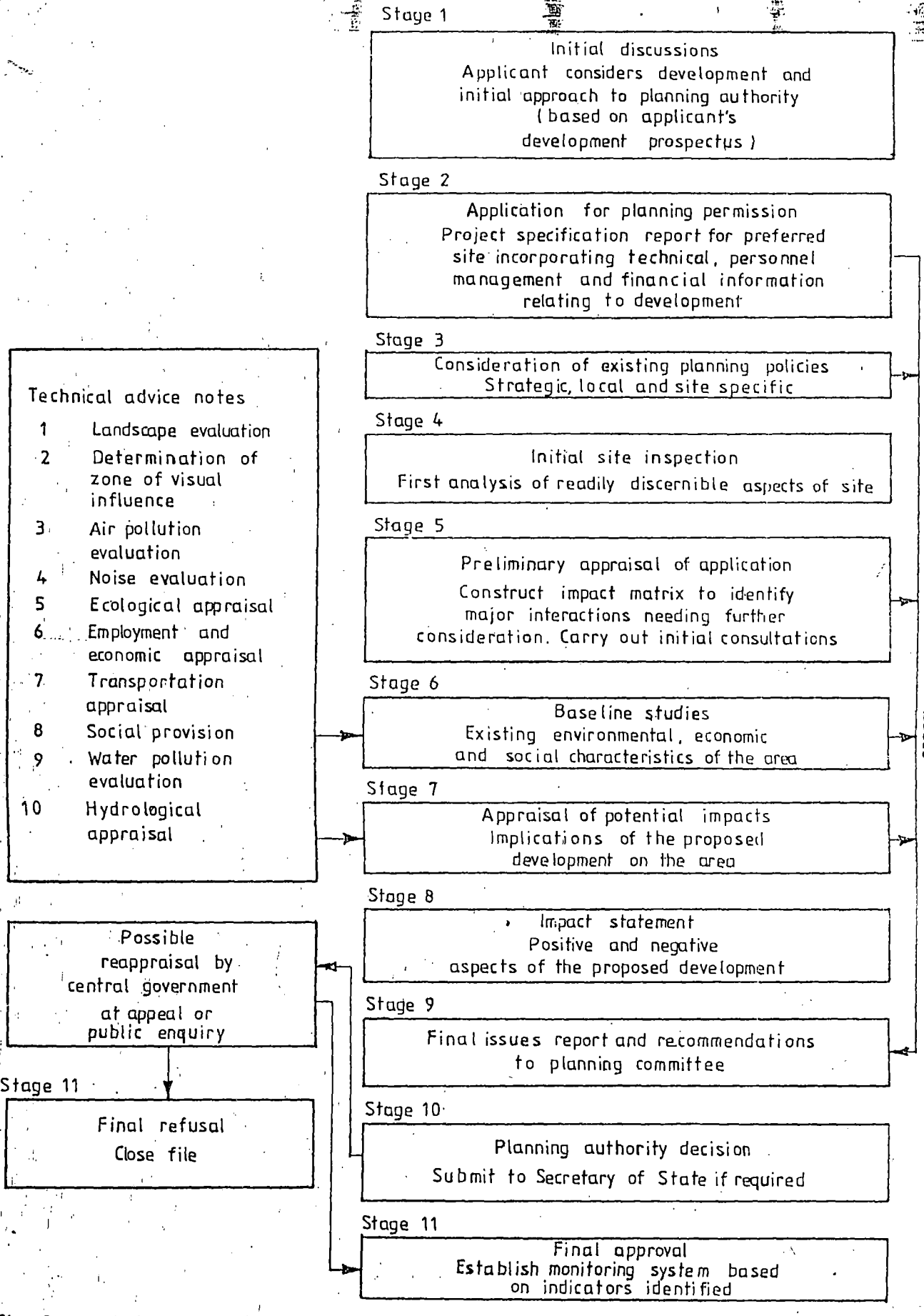


Fig. 8 An approach to project appraisal

SOURCE O Riodan and Hey (1976)

IDEAL PLANNING STRUCTURE

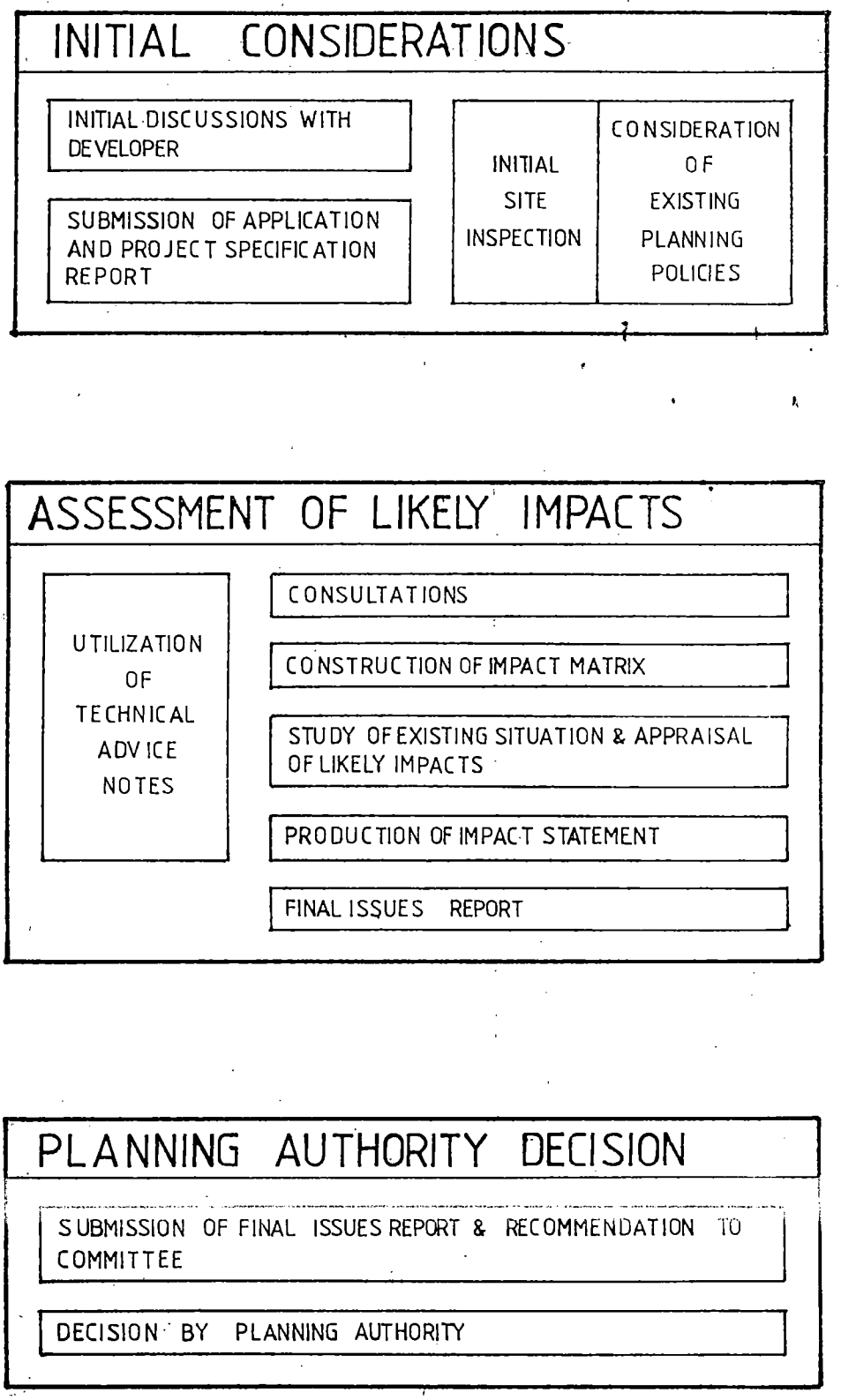


Figure 9

SOURCE Munn, 1979

However, this can be overcome by insisting that the developer bears the cost of carrying out EIA or else planning permission will not be granted. This raises many questions for Third World countries which still want to attract developers. Most governments may feel that this will chase away development from their countries perhaps to countries which are not strict and allow toxic wastes to be dumped in their countries.

The same issue can further be amplified by the argument that Third World countries must at the moment not go so much for control but permissive approach which will attract development. This becomes a dilemma for most developing countries. The insistence on EIA without proper monitoring afterwards has to be discouraged. There is need for authoritises to constantly monitor development to make sure that all negative impacts have been rectified. So at the signing of the contract there must be a clause which makes it obligatory for the developer to also take care of post-development problems which may be related to a development.

Zimbabwe is not different from the other Third World countries as far as the implementation of EIA is concerned. There have been very few projects which have been subjected to this analysis. The recent case of the Mobil Oil Company's exploration activities in the Zambezi Valley has been a test case. The government was not prepared for the exercise and there was confusion over the roles to be played by the various government agencies involved with the environment.

The manner in which the Zambezi Valley EIA was conducted did not follow the proper EIA procedure. Ideally the responsible government body, ie the Ministry of Environment and Tourism, draws up the guidelines to be follwed in the preparation of an EIA. The study has therefore to be prepared according to these guidelines. This was not done in the case of Mobil Oil Company's study of the Zambezi valley. The argument given for not following the properly laid down international procedure for EIA is that there was not enough time. As a result no real fieldwork was carried out and conclusions are drawn on in an 'a priori' manner. As a result the report of the ULG consultants for Mobil tends to make many sweeping statements with no proper evidence or posing alternative scenarios for some of the project actions.

The issue of major concern with the Mobil Study is the fact that the study was carried out as an after thought and not as an integral part of the oil exploration exercise. This means that the results of the study were not going to change anything since permission had already been granted to the company.

The methodology used for the study is also quesionable. No description of the methodology is offered at all and there is very little empirical data to back up some of the conclusions. The main

reason for not doing the job thoroughly is that there was very little time for a proper EIA study to be carried out. However this cannot be taken as valid excuse for a job poorly done.

5.2 CONCLUSIONS

EIA has a lot of merits and if properly carried out, a lot of environmental problems could be avoided. Its ability to predict impacts is a positive element. In aworld where there is so much competition, it is necessary to make the polluter pay for damaging the environment. This approach affords that opportunity. EIA has been applied in a number of countries with varying degrees of success.

One of the main problems is that EIA methodologies are as yet not hundred percent foolproof in terms of the results they produce. There is always that element of uncertainty which makes it very difficult to come up with an absolutely correct assessment when dealing with the environment. However, Wathern , 1979, argues that EIA has a lot of benefits. His conclusion stems from an analysis of the many projects which have had to be modified as a result of being subjected to EIA. The modifications have been in most cases to rectify harmful impacts which could have been allowed had it not been for EIA. Public involvement in the developed world has been one of the strongest points of EIA. Many people have taken keen interest in issues that affect them. This is seen from the high incidence of litigation that has taken place, especially in the USA. Developers have been taken to court by pressure groups representing communities. On the other hand this indicates that public meetings are an inadequate forum for resolving issues.

Another issue which has led to decreased efficiency of EIA are the delays which may result as differences are being reconciled. The waiting process may be costly to the developer and this may result in projects which would have been beneficial being abandoned. The screening and scoping exercises can avoid these problems if they are properly carried out.

There are still some constraints which hamper the successful adoption of EIA in the Third World. These range from a general lack of political will or awareness of the need for environmental assessment; insufficient public participation, lack of institutional base, insufficient skilled manpower, lack of data and insufficient financial resources. These problems have to be overcome first if EIA is to be satisfactorily adopted by Third World countries. Research has revealed that 66% of countries in SE Asia and the Pacific have passed legislation requiring EIA for certain types of projects, compared to 57% of countries in Latin America and 41% in Africa and the Middle East. (Kennedy, 1989). This is because the case for development in most Third World countries may be more overwhelming than the need for EIA. It has been argued that the environmental consequences of poverty are

worse than those of development. The poverty cycles in these countries is such that people are already damaging the environment. It is only development to a certain level which can move these people from poverty and an appreciation of environmental issues. This assertion is true to a certain extent. Most people in these Third World countries are leaving in marginal environments where the damage they are causing to the environment is probably the same or even greater than that which may result from any development projects in these areas.

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